man and other vertebrates in a similar manner; evidences of accident and disease among wild animals.

Presumed lines of human descent may be indicated better than by diagrams upon a plane surface, by placing actual representatives of the various groups, not upon fixed shelves, but upon brackets capable of adjustment.

The candid teacher or curator will endeavor to show not only the facts which seem to support evolution, but also those which constitute its difficulties.

A statue of Darwin has recently been unveiled in London with honorable ceremonies. What monument to his memory could be more appropriate or lasting than the formation, in all educational institutions, of collections especially designed to exhibit the facts which he made significant, and the ideas which his knowledge, his industry, and his honesty have caused to underlie the intelligent study of nature throughout the world?

PROCEEDINGS OF THE SECTION OF BIOLOGY.

THE biological section opened with two papers by Prof. E. L. Sturtevant as the result of observations and experiments at the New-York agricultural experiment station. The first, on the hybridization and cross-fertilization of plants, showed in a conclusive manner that in our common vegetables (peas, corn, beans, barley, lettuce, are some of the forms experimented with), cross-fertilization tends toward atavism rather than to a blending of individual properties of the parent plants. As a rule, all the crosses tended to revert to an ancestral form, regaining in many cases characters which the immediate parent had lost. The paper forms a valuable contribution to the subject of the origin of species, on account of the carefulness of experiment and accuracy of observation apparent in the work. In the second, 'Germination studies,' the author states, as a result of many trials with commercial seeds of our common plants, that very extended series of trials must be made with each species in order to obtain the desired accuracy in results; since in a short series of trials many errors will probably occur which would be eliminated from the final result by the use of a larger series. Prof. W. J. Beal of the Michigan agricultural college described an experiment on the longevity and endurance of seeds — in which ripe seeds were buried in sand below frost for five years, at the end of which time they were exposed to frost for a period of two years and a half more.

An interesting paper on the biological deductions to be drawn from a comparative study of the influence of cocaine and atropine on the organs of circulation, was given by Dr. H. G. Berger, U.S.N. The generally accepted opinions regarding the use of atropine, muscarine and cocaine, on the organs of circulation, are, that atropine induces an augmentation and acceleration of the circulation by paralyzing the vagus nerve-endings in the substance of the heart; and that muscarine, by acting as a stimulus to the same nerve-endings, produces diastolic arrest. The later view of Glouse, however, is, that the arrest is due to its paralyzing influence on the muscles of the heart. The main points in these two views are, 1°, that the action is purely a nervous phenomenon; 2°, that it is purely muscular. When atropized blood is put into a frog's heart, the organ is first highly stimulated, but shows evidence of exhaustion by over-stimulation; this is associated with a break in the rhythm of the beats, the auricles contracting two to three times oftener per minute than the ventricles: the dose of atropine can be so regulated that this unrhythmical action may be kept up indefinitely, and even be reproduced in a heart which has recovered from atropization in normal blood. The most rational explanation of this phenomenon is found in the facts, that, while muscarine paralyzes, atropine stimulates, the cardiac muscles as well as the cardiac nerve-endings; though in case of the latter only in a slight degree. Cocaine affects the nerve-endings within the heart much the same as atropine, but is not a muscular stimulant. From his researches, Dr. Berger reached the conclusion that the drugs used acted directly on the muscle-tissue, producing paralysis, and not indirectly through the nerve-endings, — a view which was combated by Profs. Charles A. Sewall and H. N. Martin in the discussion which followed the reading of the paper.

'On the brain and auditory organs of a Permian theromorph saurian' was the title of an interesting paper by Prof. E. D. Cope. The author called special attention to the morphology of the brain, the character of the cranial walls and the auditory apparatus. The characters of the brain were considered to show affinities to the reptilian and the simpler mammalian types. The corpora quadrigemini are small, and the cerebral hemispheres exceedingly small — relatively inferior in bulk to those of any other known animal. The epiphysis is larger than is usual for reptiles. The absence of an optic foramen is a very striking character. This form is peculiarly characterized by the presence of a large oval foramen in the frontal region, the exact nature of which has not been determined. The vestibule and its walls were thoroughly described, and the relations of the well-formed semicircular canals explained. The stapedial bone connects with the fenestra ovalis external to the brain case, and at a great distance from the cochlea — the cavity of which is a mere extension of the fenestra ovalis to the vestibule. The semicircular canals resemble those of modern reptiles.

Mr. A. W. Butler presented many interesting facts concerning the habits of the musk-rat. The author mentioned well-authenticated cases of the change of habits as a means of adapting itself to the changed conditions of life, — conditions brought about by the presence of civilized man.

The disputed question of the bisexuality of the pond-scums (Zygnemaceae) was discussed by Prof. C. E. Bessey of the University of Nebraska, who concluded that these organisms do not possess true bisexuality such as Bennett of England claims for

them. All the observed facts of the conjugation of these algae tend to prove that sexuality is in its beginning, but as yet there is no differentiation into male and female elements; so that we cannot speak of a bisexuality, although there is a union of two distinct bodies of protoplasm. One fact not observed by Bennett is that of the formation of a resting spore by union of the protoplasm of two adjacent cells of the same filament. The position of the Zygnemaceae is among the lower Thallophytes, but little above the Protophytes.

'On the process of cross-fertilization in Campanula americana' was the title of a paper presented by Prof. C. R. Barnes. In this strongly proterandrous species, the pollen is scraped out of the anthers, by the hairy style, at a period anterior to the maturation of the stigmas; before the occurrence of which, the pollen has disappeared from the style. In this manner cross-fertilization is rendered certain. The pollen develops normally. The stigmas are held together until mature by interlocking papillae. The hairs on the style become introverted, and thus free the pollen. The pollen-spore contains two nuclei, the larger of which (the vegetative) becomes disorganized shortly after entering the pollen-tube, the smaller (the spindle-shaped), generative nucleus persists. The embryo sac is cylindrical with a gradual enlargement near the upper end, where is located the egg apparatus, and an abrupt enlargement at the base in which lie the antipodal cells. The pollen-tubes enter the style between the bases of the papillae of the stigma, pass down in the strands of the conducting tissue, and not through the central canal around which the tissue is arranged.

Dr. C. V. Riley presented a paper on the song-notes of the periodical cicada, and the mechanism by which they are produced. The author gave the first accurate description of the three characteristic notes of the insect, noting the variations for the individual and for thermal and hygrometric conditions of the atmosphere. The same author, in another paper, corrected the erroneous notions, that var. Cassinii Fish represents the race tredecim Riley, and that the twigs containing the eggs necessarily break off before the hatching of the larvae.

In a paper on the proof that bacteria are the direct cause of the disease known as pear blight, Mr. J. C. Arthur demonstrated by the results of his carefully conducted experiments that, 1°. Sap from an infested tree when inoculated into a healthy tree invariably produced the disease called blight. 2°. When cultures to the sixth generation of organisms were made with all precaution to prevent error, and healthy trees were inoculated with the pure culture of this sixth generation, the tree is stricken with blight, starting from the point of inoculation, and gradually extending over the whole plant. 3°. That wherever there is a blight not produced by freezing, bacteria of this species are invariably present. In order to complete the value of this work, there yet remains to discover some certain method of prevention or cure.

A paper on aquatic respiration in soft-shelled turtles (Aspidonectes and Amyda) was presented by Profs. Simon H. and S. S. Phelps Gage as a contribution to the physiology of respiration in vertebrates. One of the characteristics by which reptiles are said to be distinguished from amphibians is, that their respiration is exclusively aerial at all periods of their life. This assertion is made by all authors, except Agassiz, who adds a slight qualification. On the strength of the experiments and observations of the authors, this general character must be given up, since they have demonstrated beyond a doubt that at least in the soft-shelled turtles respiration is normally and constantly carried on by means of a respiratory apparatus, whose essential features, physiologically considered, are those of a gill. There is here, as in the adult Dipnoi, and some ganoids, a double respiration, aerial and aquatic. The facts which go to prove that we have in this case to deal with aquatic respiration are, 1°. Rhythmical movements of the hyoid apparatus, by means of which water is forced in and out of the pharyngeal cavity, thus insuring a constant flow of water over the pharyngeal mucosa. 2°. The habit these turtles have of remaining under water from two to ten hours voluntarily, and their ability to endure a submersion of fifteen hours in running water without apparent inconvenience. 3°. The structure of the lining membrane of the pharynx with the copious blood-supply. The surface of the mucosa is prolonged into simple and compound papillae of various shapes and sizes, many of them recalling the gill tufts of Necturus. The fourth and absolute proof of the aquatic respiration consists in the results of chemical analyses made by Professors Rich and Holton of Cornell university, who carefully tested the water in which a turtle had been immersed without access to air, and found a marked decrease in the amount of free oxygen in the water, and an increase in the quantity of carbon dioxide held in solution.

The following table shows the result of the analyses. In the first column is given the amount of oxygen in the quantity of water used in the experiment (1 kg). The second column contains the quantity of CO_2 which could be made from this O. The third column contains the actual amount of the CO_2 found in the water, the excess of which over the amount to be from the oxygen in water itself is given in the fourth column.

	O.	CO_2.	Actual CO_2.	Excess Co_2.
July 11,	71 mg.	$97\frac{5}{8}$ mg.	231 mg.	$133\frac{3}{8}$ mg.
Aug. 8,	32 "	44 "	$212\frac{7}{10}$ "	168.7 "
Aug. 9,	39 "	$55\frac{5}{8}$ "	168.7 "	$118\frac{3}{40}$ "

The excess of CO_2 in the water is accounted for by the presence of a certain quantity of O in the lungs of the animal at the moment of submersion, and by the intramolecular O of the tissues of the animal's body. An analysis of the contents of the lung revealed the total absence of O, and of CO_2 was found only a trace. The O is taken from the water by the papillate pharyngeal mucosa, the details of the structure of which lack of space forbids giving here.

Prof. C. E. Bessey read a paper on the inflorescence of Cuscuta glomerata. In his studies of this degraded morning-glory, the author has discovered that the dodder produces its flowers upon short, adventitious

branches, which themselves repeatedly branch, and are closely covered with scales. A further examination shows that this is the universal rule with the species, no normal inflorescence developing. The adventitious inflorescence always bears a definite relation to the position of the parasitic roots: that portion of the stem which produces roots, always produces flowers; and the greater the number of the former, the larger is the number of the latter. The stem proper dies away soon, not only between the inflorescence, but also in the flower-clusters themselves. The flowering branches establish direct structural connection with the host plant. When this is accomplished, the scales upon the branches often contain considerable quantities of chlorophyl.

A short paper by Prof. B. G. Wilder was read on the subject of the serrated appendages of Amia. The view held by Sagemehl and Ramsey Wright, that these organs are accessory respiratory organs, is found to be sustained by the experiment which Professor Wilder performed on the living animal; and his conclusions are, that, while the appendages have no function at the present day, it is quite probable that their development and paleontological history are well worth careful study.

Dr. C. S. Minot discussed the subject of the relation between histological differentiation and death, and arrived at the conclusion, that the only rational explanation of the fact that animals and plants undergo progressive decay, as well as a progressive development, is to be found in the fact that highly differentiated structures, or organs, have lost the plasticity of embryonic tissues, and are incapable of renewing themselves when once worn out: in consequence of this, death is the price paid by the higher organisms for their advanced organization.

In another paper, on the morphology of the supra renal capsules, Dr. Minot made an important addition to our knowledge of the structure of these still problematical organs. The structure of the capsule is similar throughout. There are masses and cords of cells which are in radial lines externally, but which are irregularly arranged internally. The cells of the medulla and cortex are almost identical in appearance in a six months' human foetus, on which account it is difficult to admit a double origin for the capsules. The same speaker presented a paper on a new membrane of the human skin, which he homologizes with the epitrichium of the lauropsida. It is situated outside the horny layer, and is entirely distinct from it: an extension covers both hairs and glands. It probably causes the vernix caseosa by retaining the sebaceous secretion.

An interesting and important paper on the embryology of Onoclea and other ferns was contributed by Mr. D. H. Campbell of Detroit, the details of which cannot be given here. Drs. D. E. Salmon and T. Smith of Washington, D.C., read a paper on a new chromogenous bacillus (Bacillus luteus suis). This form is non-pathogenic, and was found in the pericardial and peritoneal fluids in swine killed for the purpose of studying the swine fever. When grown in a meat infusion, the liquid becomes pale straw color, then orange with a greenish tint, soon changing to a wine red. The pigment when obtained pure is insoluble in alcohol or ether. An aqueous solution is decolorized by adding an excess of strong HNO_3, or HCl, but reappears on neutralizing with potassium hydrate, or ammonia.

The relation of ovary and perianth in the development of dicotyledons was discussed by Prof. J. M. Coulter. A most simple and important character of systematic value was discovered in the study of the embryology of the dandelion; and, on comparing with the same embryonic stages of a large number of families, it was found that the character of superior or inferior ovary was the first recognized. In the case of an inferior ovary, the protuberance, which is to develop into the flower, is arrested in its axial development, grows perpendicularly into a collar (the nascent floral envelopes), and soon there appears an external constriction distinguishing the floral envelopes above from the ovary below. In the case of a superior ovary, the axial development is continued, and there is no external constriction. On such a basis the Compositae stand at the head of the list, then Umbelliferae, Rubiaceae, etc. The second group, that of a superior ovary, includes Leguminosae, Scrophulariaceae, Labiatae, etc. A paper on the structure and functions of the sphaeridia of the Echinoidea was read by Dr. Howard Ayers. The observations of Lovén were supplemented by a large number of structural facts, which, besides allowing of greater accuracy in determining the function of these peculiar organs, furnish an example of a highly specialized organ in this group that is comparable to the otolith sacs of Synapta. The following papers were read, of which extracts cannot be given here: 'The importance of individual facts of environment in the formation of groups of animals,' by Prof. J. B. Steere; 'On the morphology of the carapax and sternum of the decapod Crustacea,' by Dr. H. Ayers; 'Notes on some injurious fungi of California,' by Prof. W. G. Farlow; 'On the evolution of the lungs,' by Dr. C. S. Minot.

THE LIMITATIONS AND VALUE OF HISTOLOGICAL INVESTIGATION.[1]

WHILE choosing a subject relating chiefly to microscopic structure for the address before the section of histology and microscopy, I wish first to discuss briefly what constitutes a complete knowledge of structure, and what are the limitations and value of this knowledge. The knowledge of structure depends greatly upon the coarser, i.e., the macroscopic relations. There is no magic in the microscope; it is simply a tool, nothing more. It is as illogical and hopeless to expect to understand the structure of an organ from what can be learned of it under the microscope alone, as for a geologist to expect to understand the topography of a continent by studying the sand of its sea-shore.

[1] Abstract of an address delivered before the section of microscopy and histology of the American association for the advancement of science, at Ann Arbor, Aug. 26, by Prof. S. H. GAGE of Cornell University, vice-president of the section.